IMPROVED SPECIES AND SEASONAL PASTURE PRODUCTION

J. A. Lancashire
Grasslands Division, DSIR, Private Bag,
Palmerston North.

ABSTRACT

The range of improved herbage species currently available and under evaluation in New Zealand are briefly reviewed. The seasonal herbage production of 7 species and cultivar combinations was measured under grazing during the establishment year in 1977-78. The year included the driest January-April period ever recorded in the Manawatu. The comparisons included simple and complex permanent pastures, medium and short-term mixtures and a special purpose clover sward.

Pawera red clover, Nui perennial ryegrass, Matua prairie grass and chicory showed potential for easing feed deficits in summer and/or autumn. The short-lived ryegrasses showed most promise in overcoming feed shortages in winter and early spring.

BACKGROUND

Improved herbage species have played an integral part in the development of N.Z. grasslands with the first N.Z. selection material being released 40-50 years ago (Table 1).

TABLE 1. Herbage cultivars developed by Grasslands Division.

Present Cultivar Name*	Common Species Name	
Ruanui	Perennial ryegrass	1936
Huia	White clover	1936
Turoa	Red clover	1937
Paroa	Italian ryegrass	1938
Manawa	Hybrid ryegrass	1943
Hamua	Red clover	1946
Kahu	Timothy	1947
Apanui	Cocksfoot	1953
Ariki	Hybrid ryegrass (perennial type)	1965
Tama	Westerwolds ryegrass	1968
Matua	Prairie grass	1973
Pawera	Red clover	1974
Nui	Perennial ryegrass	1975
Maku	*Lotus pedunculatus (L. major)*	1975
Pitau	White clover	1975

* The older cultivars were re-named in 1964.

Other improved species which have been widely used and are not shown in the table include lucerne and subterranean clover, while limited use has been made of imported lines of improved and/or commercial lines of species such as tall fescue, paspalum, phalaris and lotus. Many aspects of the characteristics and management of the older cultivars such as their response to variable defoliation patterns, soil fertility, seasonal and regional climatic differences and compatibility in mixtures have been well covered in the literature and will not be reiterated here. Two major developments are evident in Table 1 and in the range of new plant material currently being evaluated (Table 2)

viz.
1) The increasing rate at which new cultivars are now being released
2) A trend to increased specialisation in cultivar use

However, the major question that must be answered in relation to this symposium is whether the new species and cultivars can produce more feed of the right quality to help overcome the seasonal deficits which currently limit animal production. It will be assumed in this paper that these plants will only be used where some form of planned grazing can operate, because controlled defoliation is essential if many of the new cultivars are to fully express their genetic potential for increasing yields (Lancashire, 1977).

TABLE 2 Experimental herbage cultivars under evaluation.

Grasslands Number	Common Species Name
G4703	*Lotus pedunculatus*
G4708	Hybrid ryegrass
G4709	Italian ryegrass
G4710	Tall fescue
G4712	Lotus hybrid
G14	Phalaris
G15	Paspalum
G16	Cocksfoot
G17	Cocksfoot
G18	White clover
G19	Serradella

MATERIALS AND METHODS

The contribution of various species and cultivars to seasonal herbage production are illustrated by data obtained from the first year of a grazing trial comparing 7 different species and cultivar combinations recently established at Grasslands Division, Palmerston North.

The mixtures were broadcast sown by hand on a fertile Kairanga silt loam (J. D. Cowie, pers. comm.) on 6 April 1977 in a randomised block design with 3 replications. Paddock size was approximately 1/25 hectare. A description of the mixtures and sowing rates is shown in Table 3.

The experimental lines used in the trial were:

'G4708' a tetraploid hybrid ryegrass derived from 'Grasslands Ariki', but more similar to 'Grasslands Manawa' than Ariki in growth characteristics and animal acceptability. However, Manawa is more productive in the cool season particularly in the first year, but is generally less persistent than G4708 (C.S. Armstrong, pers. comm., Lancashire, unpublished)

TABLE 3. Mixtures, sowing rates (kg ha^{-1}) and description of 7 pasture types.

Mixture	Ryegrass		White Clover		Red Clover		Other Grasses		Other Species		Description
1	Ruanui Manawa	15 5	Huia	3	Hamua	3	Apanui	4	–		Permanent general purpose mixture of older cultivars
2	Nui G4708	15 8	Pitau	3	Pawera	5	G16	4	-		Permanent general purpose mixture of new cultivars and experimental lines
3	Nui	20	G18	3	–		–		–		Permanent simple mixture
4	G4708 Manawa	8 5	Pitau	3	Pawera	5	Matua	40	–		Medium term (3-4 years) high production pasture with grasses renewable into perennial legume base
5	G4709 Manawa	25 10	G18	3	Hamua	6	–		–		Short term (1-2 years) high production pasture
6	–		G18	4	Pawera	10	–		–	–	Special purpose high quality legumes
7	Nui G4708	8 4	Pitau	2	Pawera	4	Matua G15 Kahu G16	5 3 2 2	Woogenellup* Chicory** Maku Maitland***	2 2 ½ ½	Permanent general purpose 'cocktail' mixture.

* Subterranean clover
** Commercial line
*** *Lotus corniculatus*

'G4709' a tetraploid Italian ryegrass derived from 'Grasslands Paroa'. It is generally higher yielding than Paroa (I.M. Ritchie, pers. comm.) but in growth habit, dry matter content and appearance more closely resembles 'Grasslands Tama'. However, it is more persistent than Tama and, particularly in wet summers, can survive quite well into a second year (C.S. Armstrong, pers. comm.)

'G15' *Paspalum dilatatum* was selected at the Kaikohe regional station from South African introductions. In most evaluations it has outyielded the commercially available lines of paspalum (Percival and Couchman, 1978).

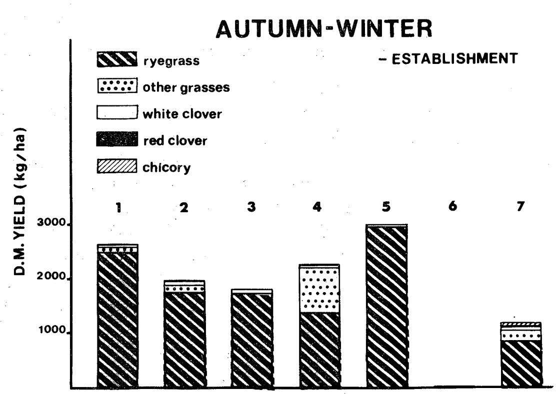
'G16' cocksfoot is a hybrid between tetraploid *Dactylis lusitanica* and 'Grasslands Apanui' *(D. glomerata)*. It generally outyields Apanui particularly in winter and also has a higher *in vitro* digestibility (W. Rumball, pers. comm.).

'G18' white clover was bred from crosses between 'Grasslands Pitau' and Ladino. It is a large leaved erect plant with high summer and winter yield but probably requires lax grazing for maximum performance (W. M. Williams, pers. comm.).

All mixtures were periodically grazed with wether sheep for periods of 24-48 hours at each grazing. Management was designed according to the principles developed by Brougham (1968) and mixtures 1, 2, 3, 4, and 7 were grazed eleven times during the year, mixture 5 ten times and mixture 6 eight times.

Figure 1: DM yields (kg ha^{-1}) during the establishment period. Autumn-Winter 1977.

L.S.D. 5%		
	Total	696
	Ryegrass	828
	White clover	40
	Red clover	16



RESULTS AND DISCUSSION

Seasonal yields of sown species are shown in Figures 1-4.

Figure 2: DM yields (kg ha^{-1}) during the spring 1977.

L.S.D. 5%	Total	1 373
	Ryegrass	1 128
	White clover	362
	Red clover	292

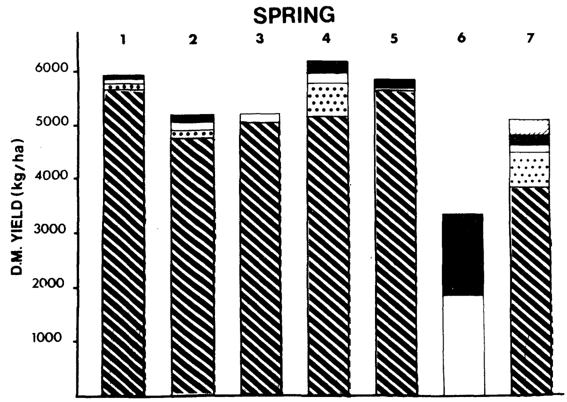


Figure 3: DM yields (kg ha^{-1}) during the summer 1977-78.

L.S.D 5%	Total	751
	Ryegrass	775
	White clover	399
	Red clover	468

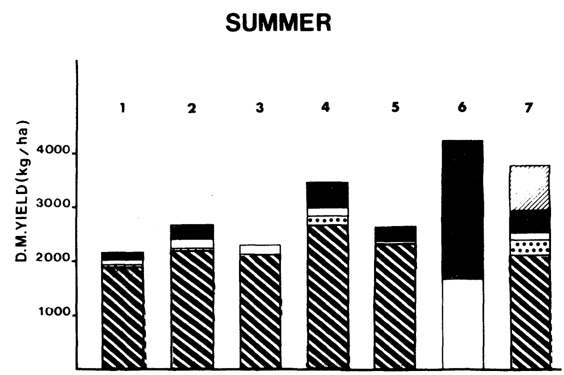
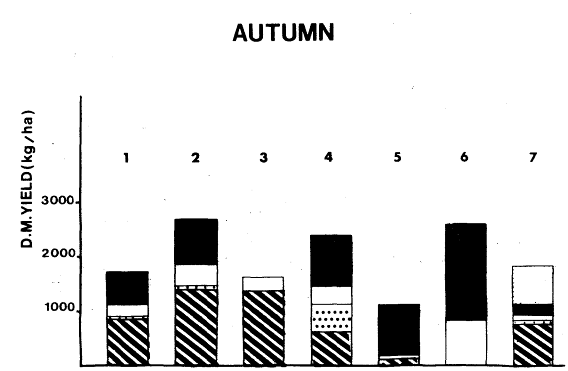


Figure 4: DM yields (kg ha^{-1}) during the autumn 1978.

L.S.D. 5%	Total	824
	Ryegrass	259
	White clover	345
	Red clover	591



Establishment period April-August

Ryegrass was the main component of yield in all mixtures, except the pure legume sward, with the treatments containing the fast establishing, short-lived types like G4709 (5) and Manawa (1) generally outyielding those with only Nui perennial ryegrass (3) or Nui and G4708 (2). Yields of Matua prairie grass were not high (4) and establishment on this winter wet soil type, particularly from late sowings, was slow compared with winter active ryegrassses (see also Table 4). The low total yield of mixture 7 was caused by poor ryegrass growth with the inclusion of other grasses and species such as cocksfoot, timothy, prairie grass and subterranean clover failing to compensate for the low seeding rate of ryegrass.

These results clearly demonstrate the importance of ryegrass, particularly the short lived types, in achieving high pasture yields over the winter. Additional data from a mowing trial on an adjacent site on the same soil type (Table 4) illustrate the range of yields obtainable from pure swards of the different ryegrasses and Matua prairie grass.

TABLE 4. Yield of winter active ryegrasses and Matua prairie grass (May-September) (kg ha^{-1}). Sown 29 April 1977.

Grass	Yield kg ha^{-1}	
Tama	3210	a
Introduction	2726	ab
G4709	2348	bc
Paroa	2075	cd
Manawa	1616	d
Matua	503	e

Spring (September-November)

The pattern of ryegrass yields was broadly similar to that shown in the establishment period although only yields in treatment 7 were significantly inferior to the other mixtures. However, increased contributions from other grasses notably timothy (9%) and also chicory (6%) meant that the total yield in the cocktail mixture was not significantly different from the other treatments containing ryegrass. The production of Matua in mixture 4 was again relatively poor and in fact its contribution to total yield dropped sharply from 30% in July to only 3% at the end of November. A similar pattern was shown in mixture 7 where the species contribution fell from 9% to nil over this period. The reasons for this decline are not clear but it is probably related to higher growth rates of ryegrass in spring (Baars and Cranston, 1977) and a differential response to grazing pressure (Pineiro and Harris, 1978a) and/or soil fertility (Rys *et al.*, 1977). However, the results illustrate that it may be difficult to maintain Matua at a reasonable level in mixtures with ryegrass during the spring so that it may not be possible to capitalise on its potential for summer growth (see below).

Red and white clover yields were still extremely low (<5% of the total) in all the mixtures with grasses, but the potential of the G18/Pawera combination was shown by a growth rate of over 30 kg ha^{-1} day^{-1} during the period. Although this was substantially below that achieved in the best grass dominant swards the feed quality of these leafy legume swards would have been considerably higher particularly at a time when digestibility of ryegrass was declining because of inflorescence development.

Summer (December-February)

Mixtures 4, 6 and 7 were substantially superior to the other combinations during this period. Although ryegrass was still the major component there were no significant differences among the treatments in ryegrass yields and the increases in total yield were mainly the result of superior growth of red clover in the three mixtures and chicory (22% of yield) in mixture 7. The other main sown grasses, Matua in mixture 4 and Kahu timothy in mixture 7 contributed only 5% of yield during the period. The performance of Matua in particular was disappointing as pure swards of the species produced very well throughout the drought in the adjacent mowing trial referred to above, and clearly it has a high potential for summer and autumn production under dry conditions (Table 5).

TABLE 5. Yield of winter active ryegrasses and Matua prairie grass during summer and autumn 1978 (kg ha^{-1}).

Grass	Yield Kg Ha^{-1} 5 January - 14 April	9 May (regrowth after autumn rain)
Tama	112 a	–
Introduction	297 a	–
G4709	605 a	–
Paroa	336 a	–
Manawa	277 a	190 a
Matua	4 603 b	2 220 b

White clover yields were low in all grass/legume mixtures and rarely contributed more than 5%.

Autumn (March-May)

This was the poorest season for ryegrass growth and in most mixtures it contributed less than 50% of total yield. Red clover yielded more than in the summer period in most of the mixtures and was the predominant species after ryegrass. The value of the species at this period was well illustrated by the comparison between the two Nui based mixtures 2 and 3 as the increased yield of 2 was almost entirely accounted for by the presence of red clover. The value of Nui at this period was confirmed by the significantly higher ryegrass yields in mixtures 2 and 3 while the low yield of mixture 5 was caused by the almost complete disappearance of G4709 and Manawa. However, despite a relatively low ryegrass yield from G4708 and Manawa mixture 4 remained one of the highest yielding treatments because of a good contribution from red clover and a marked recovery in the growth of Matua. The decline in the relative yield of the cocktail mixture appeared to be mainly the result of a 56% fall in red clover yield between summer and autumn, whereas all the other grass legume combinations showed at least 100% increase in red clover between the two periods. The only other major difference between the cocktail mixture and the other grass/legume combinations at this time was the presence of a vigorous chicory component which increased its yield contribution from 22% in summer to over 40% in autumn. Despite this increase the actual yield of chicory fell slightly between periods so it appeared that although the plant exerted a strong competitive effect on red clover it could not compensate for the loss of potential yield from that species.

The yield of white clover remained relatively low in all grass/legume combinations and did not exceed 15% in any treatment.

CONCLUSIONS

Although the data from an establishment year must be interpreted carefully, some of the results are of particular interest because the January-April period in 1978 was the driest ever recorded in the Manawatu (J.L. Brock, pers. comm.). In addition the late summer early autumn period was typical of many dry years in the past decade where substantial autumn rainfall has not occurred until at least mid-April. The results suggest that Nui and Pawera could substantially assist in easing feed deficits during summer and/or autumn while Matua and possibly chicory also appear to have some potential. The well-known limitations of the currently available lines of white clover in dry conditions were exposed during this trial and were mainly responsible for the relatively poor performance of the simple Nui/G18 mixture during the dry period. However, G18 performed much better in the mixture with red clover and produced over 2,200 kg ha^{-1} during the summer and autumn. This mixture may have potential on some soil types as a special purpose alternative to lucerne, because although red clover is generally lower yielding than lucerne in the dry season the inclusion of G18 increases the cool season activity of the established mixture and the two species appear to be compatible under grazing (Table 6).

TABLE 6. Botanical composition of the G18 white clover/Pawera red clover sward (%).

Month	Legume G18	Pawera
December	49%	33%
January	30	54
April	18	76
May	44	45
July	76	19

Recent studies with Pawera (Hay *et al.*, 1977) and earlier work with Turoa (Ch'ang, 1963) demonstrated that it was unwise to graze ewes for extended periods on pure red clover swards, particularly at tupping, because of possible infertility effects caused by the relatively high levels of formononetin present in the red clover cultivars currently available in New Zealand (Lancashire, Keogh and Biggs, unpublished; R.J.M. Hay, pers. comm.). In the current experiment mixtures 5 and 6 were strongly red clover dominant in autum (Figure 4) and were probably unsuitable for grazing the ewes during mating. However, the red clover content of all the other mixtures rarely exceeded 30%-40% at this time (Figure 4) and thus there would have been a considerable dilution of the oestrogenic potency of these pastures (Davies and Maller, 1970). Some other important aspects must also be considered if red clover, notably Pawera, is to be widely used to overcome seasonal feed deficiencies. These are:

a) The lack of serious effects on cattle fertility by oestrogenic plants (Cox and Braden, 1974).
b) The high feeding value of red clover for animal production (Ulyatt *et al.*, 1976).
c) The use of hay as a conservation procedure to reduce the formononetin content of red clover to an acceptable level (Hay *et al.*, 1977).

The advantages of the short-lived ryegrasses in easing feed deficits in winter and early spring were clearly demonstrated, but to gain the maximum advantage these species require high fertility and establishment in early autumn. The place of Matua and this time of year particularly in mixtures with ryegrass is not clear. This cultivar also requires high fertility for maximum performance (Rumball, 1974) and there is evidence that it does not establish quickly (Table 4) or perform well in wet soils (I.M. Ritchie, pers. comm.). However, several trials have established its potential for winter growth (Rys *et al.*, 1977 Wilson, 1977); and it is certainly more persistent than most of the other winter active ryegrasses (Table 5). It also has a widespread flowering period which can result in considerable natural reseeding and replacement of a depleted plant population (Pineiro and Harris, 1978b). This characteristic which is also found in Manawa ryegrass (Brougham, 1961) has been used on farms for many years to successfully maintain pastures containing this cultivar (Iversen, 1957; Willis, 1957).

ACKNOWLEDGEMENTS

Tom Lyons, Les Tilbury, Bruce Baker and Peter Drake for skilled assistance with all aspects of the trial. Yvonne Gray and staff of Herbage Laboratory for herbage dissection.

REFERENCES

Baars, J.A. and Cranston, A. 1977. Performance of 'Grasslands Matua' prairie grass under close mowing in the Central North Island. *Proceeding of the New Zealand Grassland Association 39:* 139-147.

Brougham, R.W. 1961. Some factors affecting the persistency of short-rotation ryegrass. *New Zealand Journal of Agricultural Research 4:* 516-522.

Brougham, R.W. 1968. Some limiting factors to pasture production. *Proceedings of the Australian Grasslands Conference.* 225-246.

Ch'ang, T.S. 1963. Genotype-pasture interaction in the fertility of Romney Marsh ewes. *Proceedings of the New Zealand Society of Animal Production 23:* 100-106.

Cox, R.I. and Braden, A.W. 1974. The metabolism and physiological effects of phyto-oestrogens in livestock. *Proceedings of the Australian Society of Animal Production. 10:* 122-129.

Davies, H.L. and Maller, R.A. 1970. The fertility of ewes grazing pastures containing different proportions of subterranean clover in South Western Australia. *Proceedings of the Australian Society of Animal Production. 8:* 394-399.

Hay, R.J.M., Kelly, R.W. and Ryan, D.L. 1977. Some aspects of the performance of 'Grasslands Pawera' red clover in Southland. *Proceedings of the New Zealand Grassland Association. 38* (2): (In press).

Iversen, C.E. 1957. The use of short-rotation ryegrass at Lincoln College. *Proceedings of the New Zealand Grassland Association. 19:* 62–66.

Lancashire, J.A. 1977. Growing more pasture when we need it. *Massey Dairyfarming Annual:* 40-50.

Percival, N.S. and Couchman, J.N. 1978. Evaluation of paspalum *(Paspalum dilatatum* Poir.) selections I. Variation among populations. *New Zealand Journal of Experimental Agriculture:* (In press).

Pineiro, J. and Harris, W. 1978a. Performance of mixtures of ryegrass cultivars and prairie grass with red clover cultivars under two grazing frequencies. I. Herbage production in the establishment year. *New Zealand Journal of Agricultural Research 21:* 83-92.

Pineiro, J. and Harris, W. 1978b. Performance of mixtures of ryegrass cultivars and prairie grass with red clover cultivars under two grazing frequencies. II. Shoot populations and natural re-seeding of prairie grass. *New Zealand Journal of Agricultural Research:* (In press).

Rumball, W. 1974. 'Grasslands Matua' prairie grass. *New Zealand Journal of Experimental Agriculture. 2:* 1-5.

Rys, G.J. , Ritchie, I.M., Smith, R.G., Thomson, N.A., Crouchley, G. and Stiefel, W. 1977. The performance of 'Grasslands Matua' prairie grass in the Southern North Island. *Proceedings of the New Zealand Grassland Association. 39:* 148-155.

Ulyatt, M.J., Lancashire, J.A. and Jones, W.T. 1976. The nutritive value of legumes. *Proceedings of the New Zealand Grassland Association 38:* 107-118.

Willis, D.R. 1957. The use of short-rotation ryegrass on a Manawatu fat lamb farm. *Proceedings of the New Zealand Grassland Association. 19:* 67-74.

Wilson, G.F. 1977. 'Grasslands Matua' prairie grass. *New Zealand Agricultural Science. 11:* 47-48.